



**National Aeronautics and  
Space Administration**

**December 24, 1998**

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**NRA-98-OES-13**

## **RESEARCH ANNOUNCEMENT**

# **SOLID EARTH AND NATURAL HAZARDS RESEARCH AND APPLICATIONS**

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**Proposals due February 19, 1999  
Email letters of intent due January 19, 1999**

**OMB Approval No. 2700-0087**

**SOLID EARTH AND NATURAL HAZARDS  
RESEARCH AND APPLICATIONS**

**NASA Research Announcement  
Soliciting Research Proposals  
for  
Period Ending  
February 19, 1999**

**NRA 98-OES-13  
Issued December 24, 1998**

**Office of Earth Science  
National Aeronautics and Space Administration  
Washington, DC 20546**

## **RESEARCH AND APPLICATIONS IN SOLID EARTH SCIENCES AND NATURAL HAZARDS**

This announcement presents an opportunity for researchers to participate in the National Aeronautics and Space Administration (NASA) research and development themes of Solid Earth and Natural Hazards Research and Applications (Appendix A). The research program aims to develop and apply NASA space geodetic and remote sensing technology in the solution of important scientific problems which improve our understanding of the dynamics of the solid earth and which demonstrate or disseminate this technology in ways that are important to society, especially in the assessment and mitigation of natural hazards. Using the unique perspective available from space, NASA is observing, monitoring and assessing large-scale earth and environmental processes. NASA's satellite data are complemented by aircraft and ground data, and enable us to better understand the earth, its changes over time, and the relationship of human activities to these changes

Participation in this program is open to all categories of organizations, both domestic and foreign: educational institutions, other nonprofit organizations, NASA centers, industry, and other Government agencies. Proposals may be submitted at any time during the period ending February 19, 1999, but not later than 4:30 p.m. e.s.t. on that date. Proposals received after that date will be returned unless it is determined to be in NASA's best interests to evaluate the proposal. Proposals will be reviewed February-March 1999. Announcements regarding selection for Fiscal Year (FY) 1999 and/or early FY 2000 funding are planned for April, 1999.

Details relevant to this solicitation are included in the Appendices to this Announcement. Appendix A provides scientific, technical and program information for the research and modeling for which proposals are sought. Appendix B provides information regarding sources of existing data and means of acquiring new data. Appendix C contains the specific guidance necessary for preparation of proposals in response to this solicitation. Appendix D contains general instructions for preparation of proposals in response to all NASA Research Announcements. Appendix E contains formats and forms required for proposals submitted in response to this NRA. Appendix F contains more detailed information regarding the Pacific Disaster Center and the modeling and simulation effort.

This NASA Research Announcement (NRA) will serve as the vehicle for soliciting basic research in areas of Solid Earth Science, applied research in Natural Hazards, Geologic Applications, Pacific Disaster Center Modeling and Simulation, and the development of supporting technology. We anticipate that the Solid Earth and Natural Hazards research and applications areas in NASA will issue a modified version of this solicitation annually, which will include flight project science team opportunities as well, when appropriate. A summary of research projects selected under the previous announcements may be found at the web sites: <http://www.hq.nasa.gov/office/ese/nra/archive/nra97mtpe10/winners.html> and [http://www.hq.nasa.gov/office/ese/nra/archive/nra96mtpe05/nra96mtpe05\\_results.html](http://www.hq.nasa.gov/office/ese/nra/archive/nra96mtpe05/nra96mtpe05_results.html).

New focus areas reflected in this NRA include modeling the risks and consequences of natural hazards in the Pacific region in support of the Pacific Disaster Center, airborne data acquisition and the Pacific Rim airborne campaign, the Shuttle Radar Topography Mission, and a cooperative Landslide hazard effort with the Italian Space Agency. **We strongly recommend that the proposer carefully review this document before submitting a proposal. Failure to follow the guidelines outlined here, in terms of scientific/technical content and format of proposal, may result in the proposal being ineligible for funding through this NRA.**

We estimate that funding for new projects related to the Solid Earth and Natural Hazards Research and Applications NRA in FY 1999 to be approximately \$2-4 million. Additionally, as

the result of a cooperative effort with DoD, approximately \$4-6 million is to be awarded for research and development activities pertinent to the Pacific Disaster Center modeling and simulation. NASA anticipates approximately 20-50 new-start awards, with annual budgets in the \$50,000.00-\$200,000.00 range and nominal award periods of one to three years (subject to annual review). Anticipated awards for support of the Pacific Disaster Center modeling and simulation efforts may be considerably larger. The selection of any proposal is contingent on the availability of funding. This announcement is available on the Office of Earth Science World Wide Web. The URL is: (<http://www.earth.nasa.gov> and look under "Research Opportunities")

The following items apply only to this Announcement:

Identifier:	<b>NRA 98-OES-13</b>
Proposals Due:	<b>February 19, 1999</b>
Copies Required:	10
Email Letters of Intent:	Due: January 19, 1998
	email message to: <a href="http://www.earth.nasa.gov/loi">http://www.earth.nasa.gov/loi</a>
	subject: <b>NRA 98-OES-13</b>
	text: PI Last Name, First Name
	PI email address
	Institution Name
	Brief Title (75 characters or less)
	Program Area (from list on E-2)

Submit All Proposals to: Solid Earth and Natural Hazards NRA  
(**NRA 98-OES-13**) Code Y  
400 Virginia Avenue, Suite 700  
Washington, DC 20024  
(For overnight delivery purposes only,  
the recipient telephone number is 202-554-2775)

Selecting Official: Director, Applications and Outreach Division  
Office of Earth Science

Additional information can be obtained from:

Dr. Clark R. Wilson, Code YO  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
202-358-1373 (Fax -2770) [cwilson@hq.nasa.gov](mailto:cwilson@hq.nasa.gov)

Your interest and cooperation in participating in this effort are appreciated.

Ghassem R. Asrar  
Associate Administrator for Earth Science

#### LIST OF APPENDICES:

APPENDIX A:	Solid Earth and Natural Hazards Research and Applications Priorities
APPENDIX B:	Supporting Facilities and Data Archives
APPENDIX C:	Guidelines for Preparation of Proposals to <b>NRA 98-OES-13</b>
APPENDIX D:	Instructions for Preparation of Proposals Submitted in Response to NASA Research Announcements
APPENDIX E:	Formats and Forms for Proposals Submitted in Response to this NRA
APPENDIX F:	Pacific Disaster Center and Modeling and Simulation Priorities.

## **APPENDIX A. SOLID EARTH AND NATURAL HAZARDS RESEARCH AND APPLICATIONS PRIORITIES**

### **Introduction**

This announcement presents an opportunity for researchers to participate in the National Aeronautics and Space Administration (NASA) research and development programs of Solid Earth and Natural Hazards Research and Applications. The research programs aim to develop and apply NASA space geodetic and remote sensing technology in the solution of important scientific problems which improve our understanding of the dynamics of the solid earth (including the interaction with atmosphere, hydrosphere and fluid core) and which demonstrate or disseminate this technology in ways that are important to society, especially in the assessment and mitigation of natural hazards.

Three basic elements comprise the Solid Earth and Natural Hazards (SENH) program: 1) The Geology Program, which is focused scientifically on the basic understanding of the interaction of processes that shape the upper crust and land surface, and technologically on developing and refining remote sensing technologies and techniques in the optical (visible through thermal wavelengths) and Microwave (multiparameter Synthetic Aperture Radar (SAR) and SAR interferometry) region of the electromagnetic spectrum; 2) The Geodynamics Program, which is focused scientifically on a basic understanding of the dynamic processes within the Earth, addressable by geodetic techniques, and the interaction of these and other global processes in the atmosphere, oceans, etc, and technologically, on the development of space geodetic techniques including Global Positioning System (GPS), GPS arrays, Satellite Laser Ranging (SLR), and Very Long Baseline Interferometry (VLBI); and, 3) The Natural Hazards Program, which is focused in particular on applications research for disaster management, and technologically on bringing research results and technology to an applied end.

This NASA Research Announcement (NRA) will serve as the vehicle for soliciting basic and applied research in areas of Solid Earth Sciences, Natural Hazards, Geologic Applications, Modeling and Simulation in support of the Pacific Disaster Center, and the development of supporting technology. We anticipate that the Solid Earth and Natural Hazards research and applications areas in NASA will issue a modified version of this solicitation annually, which will include flight project science team opportunities as well, when appropriate. A summary of research projects selected previous announcements may be found at the web sites: (<http://www.hq.nasa.gov/office/ese/nra/archive/nra97mtpe10/winners.html>) and ([http://www.hq.nasa.gov/office/ese/nra/archive/nra96mtpe05/nra96mtpe05\\_results.html](http://www.hq.nasa.gov/office/ese/nra/archive/nra96mtpe05/nra96mtpe05_results.html)).

The Solid Earth and Natural Hazards (SENH) Programs actively collaborate with partners around the world. Some fifty countries and over eighty-five domestic and international agencies participate in satellite tracking, measurements and experiments coordinated by our programs. As a result of previous NRA's, SENH joint research activities with the USGS, NOAA, NSF, EPA and FEMA were selected, along with collaborative proposals involving working groups and agencies in Asia, Europe, Australia, and the Americas.

## **Solid Earth and Natural Hazards Program Areas**

The following sections describe areas within NASA's Solid Earth and Natural Hazards Program, including areas for which proposals are sought. This research announcement does not solicit proposals in all areas but provides this information so potential proposers understand the breadth of interests within the Solid Earth and Natural Hazards program. Limitations are noted in the various sections. Furthermore there may be program areas which are solicited, but for which no proposals are selected for support, depending upon budget limitations, program balance considerations, and proposal evaluation results. Potential proposers are reminded to review Appendix C for specific guidance on preparation of proposals and criteria for selection of proposals in response to this solicitation.

### **I. Dynamics of the Solid Earth.**

NASA continues to develop satellite missions, technologies and analytical techniques to improve understanding of the dynamics of the solid Earth, including studies of the gravity field, rotational variations, magnetic field, and related problems of defining and maintaining an accurate and stable terrestrial reference frame. Infrastructural resources for such studies are described in Appendix B and include data from various satellite missions, airborne observations, and global ground-based space geodetic observations such as Very Long Baseline Interferometry (VLBI), Satellite Laser Ranging (SLR) and Global Positioning System (GPS) networks. The paragraphs below outline specific research areas sought in this announcement.

**1. Static and Time Variable Gravity Studies:** NASA continues to invest in the development of improved gravity observations, and has selected the GRACE (Gravity Recovery And Climate Experiment) Earth System Science Pathfinder mission for development and launch in 2001. GRACE will be capable of producing complete high resolution gravity field models at spherical harmonic degree and order exceeding 100, every few weeks. This should allow inferences about changes in surface loads as small as a centimeter of water (or millibar of air) over dimensions of the order of less than a thousand kilometers. Because temporal changes in the gravity field measure mass flux in the atmosphere, oceans, cryosphere, solid Earth and its core, investigations of gravity are intimately related with those of Earth Orientation and Reference Frames (Section 2, below). Furthermore, both gravity and earth orientation information complement observations about these mass fluxes that are obtained by other methods. Given the number of investigations selected under previous NRA's, only a few new investigations will be selected in this area. Of particular interest are those which can serve as pilot studies for the GRACE mission, aiming to develop methods for translating time variable gravity observations into useful estimates of quantities related to the study of geodynamics.

**2. Earth Orientation, Reference Frames, Angular Momentum of Earth Systems:** Earth orientation (including length of day, polar motion, precession and nutation, and geocenter location) is a fundamental description of the Earth and provides a measure of change within the Earth system over all observable time scales. In response to previous NRA's, a number of investigations are currently supported in this area. We anticipate

supporting no new efforts in this area this year, except those which are connected with studies of time variations in the gravity field described above in (1).

**3. Geomagnetism:** In response to previous NRA's, a number of investigations are currently supported in this area. Thus, we anticipate supporting no new activities in this area. It is anticipated that the 1999 SENH NRA will invite proposals for geomagnetic studies, including those making use of the Oersted and SUNSAT data (due for early 1999 launch), and of CHAMP and SAC-C data (due for Fall 1999 launches).

## **II. Topography & Surface Change:**

NASA is continuing the development of space-based capabilities to measure at high resolution and accuracy the Earth's surface topography and to detect minute changes in this surface using GPS, Interferometric Synthetic Aperture Radar (INSAR), laser altimetry, and other remote sensing techniques. A Space-Shuttle-based INSAR mission, the Shuttle Radar Topography Mission (SRTM), is under development and scheduled for launch in late 1999. SRTM will provide an unprecedented, high-resolution digital terrain model within a common GPS coordinate system for most land areas on Earth. Information on SRTM can be found at <http://www-radar.jpl.nasa.gov/srtm/>.

**1. GPS and INSAR Applications:** GPS field campaigns and permanent GPS stations are now firmly established as effective tools for studying the temporally-continuous nature of deformation related to tectonics, sea level change, earthquake hazards, ground subsidence, and other phenomena. NASA and other agencies currently support research efforts in all these areas. In addition, NASA supports global GPS infrastructure through the IGS (International GPS Service), and regional GPS infrastructure through the SCIGN array in Southern California. NASA also supports the development INSAR as a tool for spatially-continuous remote sensing of deformation as an observation technique complementary to surface GPS receivers. The aim is to understand the spatial and temporal variations in strain in active tectonic regions in order to better understand for example, mechanisms of deformation and the earthquake cycle.

Given NASA's mission to lead the development of space-based technologies, new proposals involving INSAR, GPS field-campaigns, or GPS permanent stations must show exceptional promise of advancing our understanding of, demonstrating the practical use of, or significantly improving these new technologies for geodetic measurements and monitoring of the Earth's surface.

Proposals which anticipate the use of UNAVCO resources for GPS support must include a 'UNAVCO requirements' sheet as part of their budget, as given in Appendix E. UNAVCO support expenses are budgeted separately by NASA but are considered in deciding the overall cost-effectiveness of the proposal.

**2. Global Sea Level:** Determining changes in global sea level is widely recognized as a challenging and significant interdisciplinary problem. This research announcement solicits interagency and interdisciplinary proposals which make use of space-based observations, together, as necessary, with tide gauge and other surface observations, to

improve the ability to determine the rate and acceleration of global sea level change. Examples of space-based observations include GPS vertical control of tide gauges, satellite altimetry, gravity field and earth orientation changes, and meteorological observations.

**3. Coastal Hazards:** The near-shore coastal environment is subject to geologic, ecologic, oceanographic and meteorologic factors which can lead to extreme storm surges, regional subsidence, flooding, erosion, and regional bathymetric changes due to sediment redistribution and resuspension. NASA seeks to establish a few pilot studies to develop time series of observations of the coastal environment for purposes of understanding coastal processes, assessing risk and evaluating and understanding geomorphic effects of seasonal and extreme storms, and to assess the potential effects of sea level change on the coastal environment. Proposals in this category should utilize NASA's or other remote sensing techniques to acquire baseline precision topographic, bathymetric, meteorologic, climatologic, and other relevant land surface data. We encourage the formation of teams of investigators, including operational agencies at various levels, to design a measurement time series observation and analysis program, including studies of historical records, around several key high risk, highly dynamic US coastal locations.

**4. Flood Disaster Management Applications:** Of all natural hazards, floods consistently rank among the highest in terms of property damage and loss of life, both nationally and throughout the globe. Despite improved understanding of weather and its predictability, and the existence of sophisticated flood warning systems, flood losses continue to rise.

Opportunities exist for reduction of flood hazards through two broad strategies: a) improved estimation of flood risk; and b) improved real-time forecasting of floods, and associated warning strategies. Both efforts will be aided by better scientific understanding of the watershed as an integrated system. NASA encourages studies applicable to a range of catchment sizes, hydrologic responses, and storm characteristics (ranging, e.g., from summer flash floods associated with convective storms in the central and eastern US to and spring snowmelt flooding in the West). Studies that address the uses and limitations of remote sensing observations in flood plain modeling, flood stage modeling, flood frequency estimation, and flood forecasting are particularly encouraged. Proposed work should focus on remotely sensed or derived parameters such as precision topography, land cover and land use dynamics, recent regional and temporal rainfall history, soil moisture, snow cover (and water equivalent), snow melt, and/or river stage for observation/monitoring and modeling.

It is expected that research and developmental activities will constitute the central focus of this activity, and all proposals are expected to have a strong science focus; for example, they should develop or use information about the physical mechanisms that lead to floods, rather than just describing flood events. However, a limited number of case studies that demonstrate innovative applications of remote sensing technologies, particularly in cooperation with disaster management practitioners such as FEMA and/or



local/regional flood management agencies, are considered appropriate as well. These studies should aim to determine the utility and limitations key remote sensing parameters and/or time series observations for improved monitoring, forecasting of the locations and severity of flooding, and/or assessing the vulnerability to flooding in watersheds.

**5. Landslides:** The Italian Space Agency and NASA are cooperating in the study of landslides. Our aim is to better understand landslide processes including initiation and propagation of slides in different geological, geographical, and meteorological settings; increased risks due to changes in rainfall and soil moisture; and are encouraging the use of remote sensing data for assessment, mitigation and warning of landslide disasters. These efforts will benefit from increased knowledge of hillsides as integrated, dynamic systems. It is anticipated that research and developmental activities will be the focus of this activity, and all proposals are expected to have a strong science focus, that is, they should develop or use information about the physical mechanisms that lead to landslides, rather than just describing or monitoring landslide events. Both agencies plan to evaluate and select a set of investigators to conduct research addressing landslide hazards. Proposers are strongly encouraged to form interagency and/or joint US/Italian partnerships to conduct the investigations. Investigators chosen through this solicitation, in addition to previous SENH-selected investigators studying landslide processes, will form a joint US-Italian Landslide Research Team which will meet and evaluate common test sites, define observation strategies, set up processes for joint development and testing of models, and review and report the results on an annual basis.

**6. SRTM/Topography and Surface Change Science Team:** In response to a NASA research solicitation in 1995 a science team was selected to pursue investigations in topography and surface change and relationships with traditional fields of hydrology, ecology, glaciology, geology, geodynamics, natural hazards, modeling and technique development. This team has provided a forum for information transfer and recommendations on data requirements for future airborne/spaceborne observations of topography and its changes, including the Shuttle Radar Topography Mission (SRTM).

NASA in cooperation with the National Imagery and Mapping Agency will be launching the SRTM in Late 1999. The German space agency (DLR) and the Italian space agency (ASI) are also cooperating in the mission. This mission will produce an unprecedented, contiguous, high-resolution digital topographic data set of the Earth's surface between approximately 60° N Latitude and 57° S Latitude. For more information, please see <http://www-radar.jpl.nasa.gov/srtm/>.

NASA continues to pursue investigations of topography and surface change and its relationships and interactions with hydrologic, ecologic, geologic, geodynamic, glacial, and natural hazard processes; topographic process modeling; and topographic/surface change observation technique development. This research announcement particularly encourages proposals for the study of Earth surface processes using SRTM data. In addition, NASA will consider proposals that address topics of SRTM radar phenomenology and data/product characterization. NASA will consider proposals with two phases: 1) establishment of SRTM data validation sites for rigorous/quantitative

verification of SRTM data characteristics and quality (beginning in FY99 and running through FY00); and, 2) scientific data analysis (beginning in late FY00 and continuing through FY02). SRTM data validation studies may propose field and/or aircraft campaigns as necessary. Scientific data analysis proposals must make use of SRTM digital topographic data to study Earth surface processes, topography, and land surface change. Proposals are encouraged to make use of the global perspective of SRTM and include regional to continental-scale studies, and/or comparative analyses of similar land surface processes in different regions of the world with different environmental/climatic settings. Proposals which seek to combine SRTM data with those from other remote sensing missions, such as the Vegetation Canopy Lidar (<http://essp.gsfc.nasa.gov/vcl/>) to be launched in 2000, to improve process understanding and/or improve SRTM data characteristics are also encouraged.

The German space agency (DLR) issued a similar announcement in the summer of FY98. Investigators selected under that solicitation, along with investigators selected under this section of this solicitation will form a joint team which will meet on an annual basis (possibly biannually) to exchange ideas, discuss data quality issues, and review research results.

### **III. Hazards of Short Term Climate Change/El Nino Cycles**

This research announcement invites proposals to study the hazardous effects of short-term climate variability, using the previous El Nino and related cycles for case studies. The effects may be manifested in increased rates and severity of storms, floods, droughts and famines, wildfires and their consequences. Proposals are solicited which seek to determine, explain, predict, and/or verify relationships between short-term climate fluctuations and these phenomena. The goal is to develop tools for assessing the vulnerability to, and subsequent consequences of, such disasters. Other Office of Earth Science programs support studies of the physical causes of climate variability, and are not appropriate in response to this research announcement.

### **IV. Thermal and Geothermal Hazards:**

**1. Wildfires:** A team of investigators in this research area was selected under the previous NRA (96 OES-05), and there are no plans to support new independent investigations at this time.

**2. Volcanic Hazards:** Many volcanoes experience changes in the days to months prior to eruption, in surface deformation, seismicity, gas and thermal flux. Of the 600 or so active volcanoes, less than 20% are monitored, even with rudimentary surveys, due to their logistical or hazard-related problems. Remote sensing and space geodetic systems can be the only practical means of acquiring data to study volcanoes and monitoring activity.

New capabilities to monitor eruption precursory activity at a volcano are under development at NASA. These include remote sensing monitoring of thermal and gas

fluxes, and monitoring of ground deformation using GPS arrays and InSAR. Co- and post-eruptive hazard assessment and monitoring techniques involving the use of remote sensing, and digital topographic data are also ongoing. A reasonably broad range of related investigations has already been funded under previous announcements, and NASA is likely to support only a few new highly innovative proposals in this area. Topics of specific interest to this solicitation include the use of remote sensing and geodetic techniques to understand the geologic controls on eruptions processes, determination and understanding of eruption recurrence intervals, the nature and dynamics of magmatic plumbing systems, lava/ash emplacement and remobilization processes, and the consequences of volcanic eruptions on short term climatic phenomena.

#### **V. Pacific Disaster Center:**

The Pacific Disaster Center (PDC internet information via [www.pdc.org](http://www.pdc.org) ) provides tailored information products to disaster managers within the Pacific Rim region including Hawaii and the Pacific Insular states. Disaster related information products that are generated at the PDC deal with natural phenomena or human-induced events that pose a threat to life and property. These events include storms (tropical storms, hurricanes, flooding, wind damage, storm surge), volcanic activity (explosive eruptions, lava flows, ash clouds, gas emissions), earthquakes, tsunamis, drought, wildfire, and the release of hazardous materials. In cooperation with the Department of Defense, NASA seeks proposals to conduct research and develop applications for understanding, assessing and modeling the risks and consequences of natural and man-made disasters in Hawaii and around the Pacific Rim region. Potential proposers should review Appendix F for more specific details on this particular aspect of the SENH solicitation.

#### **VI. Geologic Applications of Remote Sensing**

Remote sensing technology has progressed to advanced levels of practical application, particularly in the areas of visible/infrared imaging spectrometry, multispectral thermal imaging, imaging radar, topographic measurements, and high-resolution geopotential fields measurements. For example, calibrated imaging spectrometer data measure the full visible and near infrared spectrum and can be utilized to map in detail the stratigraphy of test sites as well as to identify constituent minerals and their lateral variability within stratigraphic units. Multiparameter imaging radar can be used to derive quantitative estimates of surface roughness and soil moisture under certain conditions, and interferometric radar and laser altimeters can be used to measure and monitor minute changes in the topographic surface.

NASA is particularly interested in fostering the development of applications of remote sensing data to resource exploration, environmental monitoring and protection, hydrogeology, and other areas in order to advance the capabilities of industry, applications-oriented agencies, and regulatory agencies and other public sector organizations. In response to previous NASA NRA's, a number of investigations are currently supported in this area, and we anticipate supporting only a few new activities. These proposals must utilize NASA's advanced observational technology (see appendix B) and stimulate further development or refinement of methodologies, algorithms and models for data analysis and information extraction, calibration, or integration with other data types. A joint effort with the public/private sector is required for proposals in this category.

#### **VII. Airborne Data Acquisitions and the Pacific Rim Airborne Campaign:**

NASA seeks to make its aircraft-based remote sensing capabilities and data sets (see Appendix B) available to a broad community of scientists, including those funded by other agencies. Therefore, this announcement invites proposals for limited acquisition of AVIRIS, MASTER, AIRSAR, or other NASA aircraft based data from investigators in other Federal agencies, or with funding from other sources.

In late 1996 NASA, in cooperation with 9 countries (Australia, New Zealand, Papua New Guinea, Malaysia, Brunei, Thailand, Philippines, Cambodia, and Taiwan) conducted the Pacific-Rim (PacRim) deployment of the NASA DC-8, to acquire multiparameter synthetic aperture radar data for Earth science investigations including topography and surface change, natural hazards, geologic processes, ecologic processes, coastal processes, and urban dynamics. A second deployment in early 2000 is being planned. The primary instrument on the DC-8 for PacRim II will be the NASA AIRSAR instrument; the secondary instrument will be MASTER (see Appendix B). Therefore, this announcement invites proposals for data acquisitions in the Pacific Region for the purpose of planning the Pacific Rim II campaign.

## **APPENDIX B. SUPPORTING FACILITIES AND DATA ARCHIVES**

### **NASA Resources**

An overall view of NASA resources and world wide web links to NASA centers and data archives is available at the NASA www site: <http://www.nasa.gov/>

### **1. Space Geodetic Networks and Data Resources**

#### **FLINN**

Fiducial Laboratories for an International Natural Science Network , (see "Solid Earth Science in the 1990s, Volume 1--Program Plan", NASA TM 4267, Vol 1. February 1991) was proposed as a global network of space geodetic stations with approximately 2000 km spacing integrating Global Positioning System (GPS), Very Long Baseline Interferometry (VLBI), and Satellite Laser Ranging (SLR) technology to support Earth studies. The realization of the FLINN concept remains the unifying element in space geodetic ground stations through the efforts of NASA and a variety of national and international partners. The data available from the global network of stations is described in further detail in the websites listed below. Data include high accuracy low earth orbiter and GPS satellite ephemerides, earth rotation parameters, coordinates and velocities of the tracking stations, and GPS satellite and tracking station clock information.

#### **International GPS Service for Geodynamics**

The IGS provides the global tracking network for the GPS constellation and associated data products. Further information can be found at the following website: <http://igsceb.jpl.nasa.gov/>.

#### **Crustal Dynamics Data Information Service**

An important resource for geodetic data is the Crustal Dynamics Data Information service. Data are available for all the major space geodetic techniques. This site contains information on geodetic networks such as CORS, gravity field models, and links to many other data resources. For more information, see: <http://cddis.gsfc.nasa.gov/cddis.html>

#### **VLBI Observation Programs (CORE)**

Future Plans for the Very Long Baseline Interferometry (VLBI) observing program and science rationale may be found at the following locations: <http://lupus.gsfc.nasa.gov/vlbi.html>

#### **Southern California Integrated Geodetic Array (SCIGN)**

The Southern California Integrated Geodetic Array (SCIGN) provides a dense geodetic network for the study of crustal deformation in the Los Angeles Basin and vicinity. NASA in collaboration with NSF, the USGS, state and local organizations to develop SCIGN as a possible tool for the mitigation of natural hazards and the study of earth processes. The website is: <http://milhouse.jpl.nasa.gov/>

#### **Southern California Earthquake Center (SCEC):**

The southern California Earthquake Center (SCEC) provides seismic data resources complementary to the geodetic data of SCIGN. For more information, see: <http://www.scecdc.scec.org/>

### **Other Permanent GPS Arrays**

Another GPS array in place in the San Francisco Bay area is described at the following website: <http://quake.wr.usgs.gov/QUAKES/geodetic/bard/>

### **UNAVCO**

Resources supporting GPS field and permanent sites are provided by UNAVCO, a consortium of universities and institutions with NSF and NASA support. Consultation with UNAVCO personnel is encouraged if there are questions concerning arrangements for field or permanent GPS installations: For more information, see: [http://www.unavco.ucar.edu/gen\\_info/](http://www.unavco.ucar.edu/gen_info/)

### **Global Level of the Sea Surface (GLOSS)**

An international effort to identify tide gauge networks for long term sea level and altimetry calibration studies has been organized under the GLOSS initiative. Further information is found at the website: <http://www.nbi.ac.uk/psmsl/gloss.info.html>

### **International Earth Rotation Service (IERS)**

The IERS coordinates the monitoring of the rotation of the earth, provides organization for the techniques of space geodesy, and conducts campaigns to monitor geophysical fluids and new types of analysis. Important websites include:

International Earth Rotation Service Geocenter Campaign <http://maia.usno.navy.mil/geoc.html>  
Call for Geophysical Fluids Coordinating Centers <http://hpiers.obspm.fr/iers/info/gazette.14>  
IERS General Information <http://hpiers.obspm.fr/>

## **2. Airborne Instrumentation Resources**

The Office of Earth Science Airborne Sciences program is undergoing significant changes in response to consolidation efforts. Current inform may be obtained from the NASA Airborne Science Home Page URL: <http://www.dfrc.nasa.gov/Projects/airsci/general/default/html>

Two Lockheed ER-2 (U-2R) a DC-8, and P-3B form the core fleet and provide multi-level platforms for both NASA- and investigator-owned sensors. Outsourcing flight requirements will provide a variety of additional platforms to meet observational needs, such as the Las Vegas-based Citation operated by the DOE. These aircraft are used as test-beds for advanced sensor design and satellite simulation, as well as to support scientific and other operational data collection campaigns. Various sensor systems are in use and under development, including numerous different multispectral imaging devices, a SAR system, Laser Altimeters, and a suite of large-format mapping cameras. The aircraft are equipped with GPS location systems, and continuously record position and platform attitude information inflight. All instruments are spectrally, spatially, and radiometrically calibrated on a routine basis. To request flights of the NASA aircraft and or use of NASA instrumentation, a Flight Request form is required. These

forms are available from the Dryden Flight Research Center, MS D 1623H, Edwards, CA 93523-0273 (fax: 805-277-7746, attn: Randy Albertson), or on the internet at: [www.dfrc.nasa.gov/airsci/general/SciProg/ftpprog/nforms.html](http://www.dfrc.nasa.gov/airsci/general/SciProg/ftpprog/nforms.html).

### **AIRSAR/TOPSAR**

The Airborne Synthetic Aperture Radar (AIRSAR) is an imaging radar instrument mounted on a NASA DC-8 aircraft. AIRSAR uses three microwave frequencies: P-band (68-cm wavelength), L-band (25-cm wavelength) and C-band (6-cm wavelength). AIRSAR serves both as a research tool for the development of new radar remote sensing techniques, and as a facility instrument for gathering radar data in support of scientific research programs conducted by investigators selected by NASA. AIRSAR operates in two modes: POLSAR, for fully polarimetric (4 polarizations HH, HV, VV, VH) data at each frequency; and TOPSAR, for cross-track interferometric data at C and L band frequencies to rapidly produce topographic maps of Earth. Several experimental modes are available for 1999 including polarimetric-interferometry and along track interferometry. For more information see the following website: <http://airsar.jpl.nasa.gov>.

### **AVIRIS**

The Airborne Visible Infrared Imaging Spectrometer (AVIRIS) is an instrument that operates onboard a NASA ER-2 and the NOAA Twin Otter aircrafts. The instrument is a unique optical sensor that images in 224 contiguous spectral channels, or bands, in wavelengths from the visible (400 nanometers) to the infrared (2500 nanometers). A continuous, diagnostic spectral reflectance curve can therefore be reconstructed for each picture element in a scene. Its science objectives are to study Earth's ecology, geology, snow hydrology and oceanography to achieve an understanding of the environment based on spectral reflectance characteristics. For more information, the website is: <ftp://ophelia.jpl.nasa.gov/pub/docs/html/top.htm/>.

### **MODIS/ASTER Airborne Simulator (MASTER)**

MASTER is a multispectral imaging scanner with 50 channels. There are 25 channels in the visible-shortwave infrared (0.4-2.5  $\mu\text{m}$ ), 15 channels in the mid infrared (3-5  $\mu\text{m}$ ) and 10 channels in the thermal infrared (7-13  $\mu\text{m}$ ). MASTER has an instantaneous field of view of 2.5 milliradians and a total field of view of 85.92 degrees. There are 716 pixels in a cross track scan prior to panoramic correction. The MASTER instrument is typically flown on either a KingAir Beachcraft B200 or an ER-2. MASTER has several scan speeds and can obtain images with pixel sizes varying from 5-15 m from the B200, depending on altitude, or 50 m from the ER-2. MASTER data are provided as radiance at sensor in the hierarchical data format (hdf). To find out more about MASTER including its calibration, validation and available data visit the MASTER web site at: <http://masterweb.jpl.nasa.gov>

### **MAS**

The MODIS Airborne Simulator (MAS) is a modified Daedalus multispectral scanner configured to approximate the Moderate-Resolution Imaging Spectrometer (MODIS), an Earth Observing System (EOS) imaging spectrometer scheduled for orbit in the late 1990s. MODIS is designed to acquire digital imagery for measuring earth biological and physical processes and atmospheric properties. MAS records fifty channels of sixteen bit data in the visible, near infrared, mid-

infrared and thermal portions of the spectrum. Channels include 9 bands from 0.529 - 0.969 micron, 16 bands from 1.595 - 2.405, 15 bands from 2.925 - 5.325 , and 9 bands from 8.342 - 14.521 microns. The MAS has a 2.5 mr instantaneous field of view, and when flown at 65,000 feet on the NASA ER-2 aircraft produces images with approximately 50 meter spatial resolution.

### **LASER ALTIMETERS**

Three laser altimeter sensors developed at the Goddard Space Flight Center (GSFC) for airborne measurement of Earth surface topography are available. The RASter Scanning Airborne Lidar (RASCAL), Scanning Lidar Imager of Canopies by Echo Recovery (SLICER), and the Airborne Topography Mapper (ATM) provide complementary elevation measurement capabilities that are geolocated and referenced to an absolute elevation datum by combining laser ranging data with precise knowledge of aircraft position and laser pointing attitude. RASCAL and ATM acquire a swath of high resolution, high accuracy elevation measurements by pulse time-of-flight ranging using a high-repetition-rate laser. Nominal configuration provides a 200 m swath width of 100 laser footprints from a 1 km aircraft altitude above terrain. At the 1 km altitude the laser altimeter sensor precision of ~ 10 cm. SLICER acquires a narrow swath of larger laser footprints and combines time-of-flight ranging with waveform digitization of return pulse echoes using a high-energy laser. The waveform signal from large footprints provides a means to measure ground elevations beneath dense canopies with moderate (meter-level) vertical accuracies. The waveform records the area-weighted height distribution of all reflecting elements within a footprint, including canopy elements and the underlying ground. Consistent recovery of vegetation height and ground elevations, from the waveform first and last returns, has been demonstrated for canopies with closures as dense as 95% when the footprints are sufficiently large to encompass full tree crowns and significant areas of exposed ground (e.g. greater than or equal to 10 meter diameter footprints). Elevation accuracies of several meters or better, depending on surface slope conditions, can be achieved. For more information, contact David Harding at Goddard Space Flight Center (301-286-4849)

## **3. Satellite Systems Resources**

### **TOPEX/POSEIDON**

NASA-JPL's Ocean Topography Experiment/Poseidon (France's Poseidon mission) satellite is the most sophisticated attempt yet to measure and map sea level from space. For more information, consult the web site <http://topex-www.jpl.nasa.gov/>.

### **TOMS**

The Total Ozone Mapping Spectrometer measures ozone indirectly by monitoring ultraviolet light. It has mapped in detail the Antarctic "ozone hole," which forms September through November of each year, and the distribution of ozone over the globe. In addition to ozone, TOMS measurements can also be used measure and track sulfur-dioxide in volcanic eruption plumes. NASA and the U.S. Federal Aviation Administration (FAA) are studying ways to use these measurements to detect volcanic ash clouds that are hazardous to commercial aviation. For more information, the website is: <http://skye.gsfc.nasa.gov/>.

### **SIR-C/X-SAR**



SIR-C/X-SAR is a joint project of the National Aeronautics and Space Administration (NASA), the German Space Agency (DARA) and the Italian Space Agency (ASI). SIR-C/X-SAR stands for Spaceborne Imaging Radar-C/X-band Synthetic Aperture Radar. The SIR-C instrument was built by JPL and the Ball Communication Systems Division for NASA and provides the L band and C-band measurements at four different polarizations. The L-band and C-band antennas employ phased array technology, which allows the antenna beam pointing to be adjusted electronically. The X-SAR instrument is built by the Dornier and Alenia Spazio companies for DARA and ASI and operates at a single frequency, X-band. SIR-C/X-SAR flew on the NASA Space Shuttle twice in April and October of 1994. Radar images generated by SIR-C/X-SAR are used by scientists to help understand some of the processes which affect the earth's environment, such as deforestation in the Amazon, desertification south of the Sahara, and soil moisture retention in the Mid-West, and natural hazards and are available at the EROS Data Center. For more information, the website is: <http://southport.jpl.nasa.gov/sir-c>.

#### **SHUTTLE LASER ALTIMETER**

The Shuttle Laser Altimeter-01 (SLA) precisely measures the distance to the Earth's surface from the Space Shuttle. The SLA works by transmission of a series of short laser pulses from the payload in the Shuttle cargo bay and by the subsequent reception of the weak backscattered laser radiation to the payload. SLA-01 flew on the Space Shuttle in January, 1996, and SLA-02 flew in August, 1997. Primary data on a laser pulse's time-of-flight and the spreading of the laser pulse by the Earth's surface and measureable backscatter from land surfaces, vegetation, ocean surfaces, and cloud-tops are available. These data have wide applications in a variety of Earth science disciplines ranging from topography studies to atmospheric remote sensing. For more information, see: <http://denali.gsfc.nasa.gov/research/laser/sla/sla1.html>

#### **4. GEOPOTENTIAL FIELD DATA SETS**

NASA supports through its Geopotential Field Program the acquisition of geomagnetic and gravity data sets from space borne sensors and the synthesis of global gravity and magnetic compilations.

#### **POGO-MAGSAT**

The original Magsat data with merged ephemerides useful for main field modeling, and data sorted by magnetic disturbance levels, season, and local time are available on CD-ROM from the National Space Science Data Center. For crustal field studies a Magsat data set corrected for external fields is available on American Geophysical Union anonymous ftp ([kosmos.agu.org](http://kosmos.agu.org)) , including 1-degree gridded data sets available for three recently published anomaly maps: POGO, Magsat and combined POGO/Magsat. Field models for 1900 to 1995 are available, including 1st degree external fields, and a model for the POGO-Magsat epoch which includes the main field, low degree magnetospheric field, and the Sq field.

#### **OERSTED**

The Oersted magnetic observatory satellite is planned for launch in early 1999. The website is: <http://gate.dmi.dk:8080/fsweb/Projects/oersted/>

#### **SUNSAT**

A South African satellite is planned to be launched with Oersted and will also carry a magnetometer and GPS receiver. More information can be obtained from the website: <http://sunsat.ee.sun.ac.za>.

### **Gravity Field Models**

NASA has supported the development of gravity field compilations using combined surface and satellite observations including recent JGM-3 compilation to degree and order 70 and the soon to NIMA/GSFC combined satellite/surface gravity compilation EGM96 to degree and order 360 including 30 minute gravity anomalies. The results are available at the CDDIS, described above.

### **Geodetic Satellites**

Data from a number of the geodetic satellites including LAGEOS 1 and LAGEOS 2 as well as a new series of low earth orbiting GPS receivers aboard the Oersted and Sunsat satellites are available from the CDDIS.

## **4. OTHER DATA RESOURCES**

### **EOSDIS**

The Earth Observing System Data and Information System (EOSDIS) is a comprehensive data and information system designed to perform a wide variety of functions in support of a national and international user community. EOSDIS will command and control satellites and instruments and will generate products from orbital observations as well as generate data sets from satellite and in situ observations into global climate models. Services provided by EOSDIS include: data archive, distribution and management; information management; product generation; spacecraft command and control; and data capture and telemetry processing. NASA is implementing EOSDIS using a distributed, open systems architecture. This approach allows for the allocation of EOSDIS elements to various locations to benefit from different institutional capabilities and scientific expertise. For more information, connect to the world wide web address

<http://spsosun.gsfc.nasa.gov/ESDIShome.html/>

### **ASF**

The Alaska SAR Facility (ASF), located in the Geophysical Institute at the University of Alaska Fairbanks, downlinks, processes, archives, and distributes SAR data for NASA Investigators from the European Space Agency's ERS-1 and ERS-2 satellites, NASDA's JERS-1 satellite, and the Canadian Space Agency's RADARSAT satellite. Available SAR products include: full-resolution (25 m) images; low-resolution (240 m) images; complex-format SAR data products which retain amplitude and phase information; geocoded images; and uncorrelated (raw signal) SAR data, representing the original backscattered radar signals. ASF also archives Geophysical Processing System products which input SAR data. The archive currently includes ice motion, ice classification, and ocean wave spectra products. The Geo-Data center, a joint project between ASF and the Geophysical Institute, holds many complementary data sets, each covering Alaska and nearby regions. Their data holdings include LANDSAT, NOAA/AVHRR, and AHAP images as well as USGS maps. Detailed descriptions of all supported products are available. ASF is one of several Distributed Active Archive Centers (DAACs) sponsored by NASA as part of the Earth Observing System initiative. Contact ASF's User Services at phone number 907-

474-6166 or email address [uso@eosims.asf.alaska.edu](mailto:uso@eosims.asf.alaska.edu) or <http://www.asf.alaska.edu/index.html> for more information.

### **EROS Data Center DAAC**

The Earth Resources Observation Systems (EROS) Data Center Distributed Active Archive Center (EDC DAAC) was established as part of NASA's Earth Observing System Data and Information System (EOSDIS) initiative to promote the interdisciplinary study and understanding of the integrated Earth system. Access to land processes data, including satellite- and aircraft-acquired data stored in the EDC DAAC's archives, plays an important role in promoting such study and understanding. Research performed by Earth and global change scientists investigating the conditions and processes that affect land-atmosphere and land-ocean interactions is supported by enhanced access to archived data and data products. Information about and procedures for obtaining these data are provided through the EOSDIS Information Management System. Further information is on the EOSDIS home page site <http://edcwww.cr.usgs.gov/landdaac/landdaac.html>.

### **Maui High Performance Computing Center (MHPCC)**

The Maui High Performance Computing Center (MHPCC), Kiehe, Maui, is a state-of-the-art high performance computing (HPC) facility managed under a cooperative agreement between the Air Force Research Laboratory and the University of New Mexico. Established in September 1993, the MHPCC is chartered to provide a robust, scalable parallel computing environment to service Department of Defense, government, industry, and academia.

MHPCC is one of the largest installations of IBM SP technology, with over 600 SP nodes that include Power Parallel (P2), P2 Super Chip (P2SC), and Symmetric Multiprocessor (SMP) technology. Attendant features include: direct access to 20 terabytes of on-line tape storage managed by the High Performance Storage System (HPSS); a secure computing environment; programming tools, scientific and engineering software libraries, and application software; T3 access to the Defense Research and Engineering Network (DREN) for DoD users and T3 access to the Internet for commercial and academic users and direct telecommunication links to Hawaii-based entities including the Pacific Disaster Center.

MHPCC staff is recognized for innovative and flexible approaches to advanced computing, developing solutions that include a system administration tool (Maui Scheduler), the implementation of HPSS in a production environment, and a secure computing environment.

MHPCC is an active member of the HPC community. MHPCC is a member of the DoD High Performance Computing Modernization Program (HPCMP) providing resources to the HPCMP researchers. MHPCC is also a member of the National Computational Science Alliance (Alliance), a National Science Foundation (NSF) effort led by the National Center for Supercomputing Applications (NCSA). MHPCC provides Alliance academic researchers and private industry partners with HPC resources and services.

Since 1993 MHPCC has developed expertise in Image and Signal Processing, Modeling and Training and Education, and Computational Science and Engineering. Several modeling efforts are currently underway at MHPCC include weather, tsunami, and wildfire initiatives.

As a member of the Hawaii scientific and technical community, MHPCC is committed to supporting activities such as the Pacific Disaster Center and its developmental and operational requirements, which enhance Hawaii's economic and technical efforts.

More information regarding MHPCC can be found on its web site: <http://www.mhpcc.edu>

**Appendix C.**  
**GUIDANCE NECESSARY FOR PREPARATION OF PROPOSALS IN**  
**RESPONSE TO NRA-98-OES-13**

Proposals should be prepared in accordance with Appendix D, “Instructions for Responding to NASA Research Announcements”, except for the provisions identified below. In case of a conflict, the provisions below take precedence.

With the exception of proposals in response to Appendix A Section VII (Airborne Data Acquisition and the Pacific Rim Campaign), which are described below, full proposals (Research Objectives, Detailed Work Plan, Expected Results, Relevance of Proposed Work, Role of Personnel, Data Requirements, Supporting Facilities, and References) (references may be single spaced) may be up to fifteen pages of text, double spaced, 12-pt. type, as described in full detail in Appendix E. In addition, each proposal must have a cover sheet signed by a responsible official or authorized representative of the organization, a single-page summary/abstract, and a listing of current and pending support (forms/formats for these pages are provided in Appendix E and must be utilized). The proposal format includes cover sheet, single-page summary/abstract, proposal body, resumes and listing of current and pending support, and detailed budget information. Up to two pages of additional figures and tables are specifically excluded from the 15-page limit.

The proposal must clearly identify the roles and responsibilities of the Principal Investigator, Co-Investigators, and collaborators for the proposed research. Only one proposal, from the Principal Investigator, should be submitted for collaborative efforts involving several institutions; Co-Investigator proposal copies will be returned. Generally, Co-Investigators are those who will make a critical or significant contribution to the proposed research and may (but are not required to) receive a portion of the funding if the proposal is selected. Evidence of commitment on behalf of the Co-investigator is required and may take the form of a letter from the Co-investigator or an authorized institutional official. Such evidence should be included in the budget section.

When joint-agency participation is appropriate, proposers should submit the same proposal to each agency, with copies of separate task statements and budget pages for each agency included in each proposal. In research and modeling areas where other Federal agencies have major operational responsibilities, joint-agency sponsorship or participation is expected in the development of a viable proposal. Proposals which seek support of the University NAVSTAR Consortium (UNAVCO) in GPS work must include a copy of the UNAVCO support request sheet, found in Appendix E, as part of their budget. Proposals seeking airborne instrument data acquisitions should include a completed Flight Request described in Appendix B. International response to this solicitation is encouraged on a no-funds-exchanged basis (see Appendix C). U.S. investigators wishing to participate in international projects in which NASA is a participant such as the Working Group of European Geoscientists for the Establishment of Networks for Earthquake Research (WEGENER) or the Asia Pacific Space

Geodynamics (APSG) consortium should respond to this solicitation if NASA support is desired.

With the exception of proposals in response to the Pacific Disaster Center Modeling and Simulation effort, proposals which seek support for improved techniques, instrumentation, facilities, software, or the production or refinement of data sets, must do so within the context of addressing a scientific issue within the areas outlined below.

Proposals to the Pacific Disaster Center Modeling and Simulation program should address the mission and enhance the operational capability of the PDC. Proposals should draw on, and leverage, scientific results and technology from NASA's Earth Science Program in general and the SENH program in particular, academia, the PDC, and other government agencies including NOAA, USGS, NSF, DOE, and DOD. In addition, proposals should promote partnership arrangements within the PDC environment between the research community and disaster managers in Federal, state, local and non-governmental organizations as well as the private-sector. Cooperative arrangements involving the State of Hawaii, the University of Hawaii, Hawaiian high technology companies, the PDC, and the Maui High Performance Computer Center are encouraged.

Proposals submitted in response to aircraft data acquisitions are requested to be no more than 5 pages in length. There is no need for a budget section because selected proposals will be provided data, but no funding. These proposals must be in support of an ongoing scientific study and must include a short statement on the purpose and objective of the ongoing project; a clear statement justifying the need for the unique NASA observational airborne resources; a statement of the proposers capabilities to process the acquired data; and a letter of support from the sponsoring agency stating the length of funding available to continue the project and hence process/analyze/interpret the acquired data.

Proposals submitted in response to the Pacific Rim Campaign are requested to be no more than 5 pages, and there is no need for a budget section because selected proposals will be provided data, but no funding. Instead, these proposals must be connected to a separate currently-funded investigation whose purpose is described, and which can be shown to benefit from data taken within the PacRim region. Proposals from NASA investigators should document in-country cooperation and collaboration, and propose a mechanism to support in-country costs of data acquisition during the PacRim II campaign. Proposals from investigators in possible participating countries are also encouraged and should be coordinated through in-country PacRim coordinating committees, if previously established, and propose mechanisms to support in-country costs of the data acquisition during the deployment should be addressed. PacRim II will likely include additional countries in the Asia Pacific region and the Pacific Insular States.

The main criteria for selection of proposals in response to this NRA are: meritorious science, uniqueness to NASA (that is, involving effective use of NASA or other space-

or air-borne data sets), contributions to the research priorities of this NRA, cost effectiveness, technical and logistical feasibility (all of approximate equal value). Federal administration policy relevance is also a factor but weighted less than the above mentioned criteria. Additional criteria for selection of Pacific Disaster Center Modeling and Simulation proposals include the degree to which PDC operational capabilities are enhanced by the proposed research and development activity, and degree to which proposed effort meets stated needs of the PDC.

Also included in Appendix E are Certification forms. These forms include "Certification Regarding Debarment, Suspension, and Other Responsibility Matters Primary Covered Transactions" and, for any proposal requesting funding of \$100,000 or more, "Certification and disclosure regarding payments to influence certain federal transactions (4/91)". The cover page included in Appendix E (that must be used for proposals) includes the certification statements and must be signed by a responsible official or authorized representative (a copy is included in Appendix E).

Final decisions will be made promptly and investigators will be notified through both electronic mail and surface mail. All proposers who have submitted full proposals will receive anonymous copies of review comments from the mail reviewers. Regardless of the evaluation technique, the final decisions are always made by a designated NASA selection official incorporating the recommendations of the mail and/or panel reviews, and considerations related to funds available and to the overall balance of the Solid Earth and Natural Hazards Research and Applications programs.

Proposals will be considered for periods of performance from one to three years. It is NASA's intention to fund some proposals for the full three year period of performance and to fund other proposals on a year-by-year basis. Proposers should budget to attend one investigator meeting each year, which will probably be conducted twice-yearly in conjunction with American Geophysical Union meetings.

## **GUIDELINES FOR FOREIGN PARTICIPATION**

NASA accepts proposals from entities located outside the U. S. in response to this NRA. Proposals from non-U. S. entities should not include a cost plan. Non-U. S. proposals, and U. S. Proposals that include non-U. S. participation, must be endorsed by the respective government agency or funding/sponsoring institution in the country from which the non-U. S. participant is proposing. Such endorsement should indicate the following points: (1) The proposal merits careful consideration by NASA; and (2) If the proposal is selected, sufficient funds will be made available by the sponsoring foreign agency to undertake the activity as proposed.

Proposals, along with the requested number of copies and Letter of Endorsement must be forwarded to NASA in time to arrive before the deadline established for this NRA. In addition, one copy of each of these documents should be sent to:

NASA Headquarters

Office of External Relations  
Earth Science Division  
Mail Code IY  
Washington, DC 20546  
USA

Any materials sent by courier or express mail (e.g., Federal Express) should be sent to:

NASA Headquarters  
Office of External Relations  
Earth Science Division  
Mail Code IY  
300 E Street, SW  
Washington, DC 20024-3210

All proposals must be typewritten in English. All non-U. S. proposals will undergo the same evaluation and selection process as those originating in the U. S. Non-U. S. proposals and U. S. Proposals that include non-U. S. participation, must follow all other guidelines and requirements described in this NRA. Sponsoring non-U. S. agencies may, in exceptional situations, forward a proposal without endorsement to the above address, if review and endorsement are not possible before the announced closing date. In such cases, however, NASA's Earth Science Division of the Office of External Relations should be advised when a decision on the endorsement is to be expected.

Successful and unsuccessful proposers will be contacted directly by the NASA Program Office coordinating the NRA. Copies of these letters will be sent to the sponsoring government agency.



**Appendix D**  
**INSTRUCTIONS FOR RESPONDING TO NASA RESEARCH ANNOUNCEMENTS**  
**(JANUARY 1997)**

**(a) General.**

(1) Proposals received in response to a NASA Research Announcement (NRA) will be used only for evaluation purposes. NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre-award synopsis published for individual proposals.

(2) A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

(3) NRAs contain programmatic information and certain requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRAs.

(4) A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded in response to an NRA. NASA will determine the appropriate instrument. Contracts resulting from NRAs are subject to the Federal Acquisition Regulation and the NASA FAR. Supplement. Any resultant grants or cooperative agreements will be awarded and administered in accordance with the NASA Grant and Cooperative Agreement Handbook (NPG 5800.1).

(5) NASA does not have mandatory forms or formats for responses to NRAs; however, it is requested that proposals conform to the guidelines in these instructions. NASA may accept proposals without discussion; hence, proposals should initially be as complete as possible and be submitted on the proposers' most favorable terms.

(6) To be considered for award, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation.

**(b) NRA-Specific Items.** Several proposal submission items appear in the NRA itself: the unique NRA identifier; when to submit proposals; where to send proposals; number of copies required; and sources for more information. Items included in these instructions may be supplemented by the NRA.

(c) The following information is needed to permit consideration in an objective manner. NRAs will generally specify topics for which additional information or greater detail is desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter if it contains substantive information.

**(1) Transmittal Letter or Prefatory Material.**

(i) The legal name and address of the organization and specific division or campus identification if part of a larger organization;

(ii) A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;

(iii) Type of organization: e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;

(iv) Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;

(v) Identification of other organizations that are currently evaluating a proposal for the same efforts;

(vi) Identification of the NRA, by number and title, to which the proposal is responding;

(vii) Dollar amount requested, desired starting date, and duration of project;

(viii) Date of submission; and

(ix) Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).

**(2) Restriction on Use and Disclosure of Proposal Information.** Information contained in proposals is used for evaluation purposes only. Offerors or quoters should, in order to maximize protection of trade secrets or other information that is confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting an appropriate identification in the notice. In any event, information contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

**Notice**

**Restriction on Use and Disclosure of Proposal Information**

The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and/or information that is commercial or financial and

confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

(3) **Abstract.** Include a concise (200-300 word if not otherwise specified in the NRA) abstract describing the objective and the method of approach.

(4) **Project Description.**

(i) The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance; relation to the present state of knowledge; and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the plan of work, including the broad design of experiments to be undertaken and a description of experimental methods and procedures. The project description should address the evaluation factors in these instructions and any specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Subcontracting significant portions of a research project is discouraged.

(ii) When it is expected that the effort will require more than one year, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

(5) **Management Approach.** For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and arrangements for ensuring a coordinated effort should be described.

(6) **Personnel.** The principal investigator is responsible for supervision of the work and participates in the conduct of the research regardless of whether or not compensated under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

(7) **Facilities and Equipment.**

(i) Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any Government-owned facilities, industrial plant equipment, or special tooling that are proposed for use. Include evidence of its availability and the cognizant Government points of contact.

(ii) Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for research and non-research purposes should be explained.

**(8) Proposed Costs.**

(i) Proposals should contain cost and technical parts in one volume: do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies; services; domestic and foreign travel; ADP expenses; publication or page charges; consultants; subcontracts; other miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all staffing data in terms of staff-months or fractions of full-time.

(ii) Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major work phases.

(iii) Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 1831 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).

**(9) Security.** Proposals should not contain security classified material. If the research requires access to or may generate security classified information, the submitter will be required to comply with Government security regulations.

**(10) Current Support.** For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.

**(11) Special Matters.**

(i) Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current Government-wide guidelines.

(ii) Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant Government audit agency, inspection agency, and administrative contracting officer, when applicable.

**(d) Renewal Proposals**

(1) Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. A renewal proposal should not repeat all of the information that was in the original proposal. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the research are expected to be covered during the period for which support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.

(2) NASA may renew an effort either through amendment of an existing contract or by a new award.

(e) **Length.** Unless otherwise specified in the NRA, effort should be made to keep proposals as brief as possible, concentrating on substantive material. Few proposals need exceed 15-20 pages. Necessary detailed information, such as reprints, should be included as attachments. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments.

**(f) Joint Proposals.**

(1) Where multiple organizations are involved, the proposal may be submitted by only one of them. It should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.

(2) Where a project of a cooperative nature with NASA is contemplated, describe the contributions expected from any participating NASA investigator and agency facilities or equipment which may be required. The proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an agency commitment.

(g) **Late Proposals.** A proposal or modification received after the date or dates specified in an NRA may be considered if doing so is in the best interests of the Government.

(h) **Withdrawal.** Proposals may be withdrawn by the proposer at any time before award. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

**(i) Evaluation Factors**

(1) Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.

(2) Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission.

(3) Evaluation of its intrinsic merit includes the consideration of the following factors of equal importance:

(i) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.

(ii) Offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.

(iii) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel critical in achieving the proposal objectives.

(iv) Overall standing among similar proposals and/or evaluation against the state-of-the-art.

(4) Evaluation of the cost of a proposed effort may include the realism and reasonableness of the proposed cost and available funds.

(j) **Evaluation Techniques.** Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house, others are evaluated by a combination of in-house and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. The final decisions are made by a NASA selecting official. A proposal which is scientifically and programmatically meritorious, but not selected for award during its initial review, may be included in subsequent reviews unless the proposer requests otherwise.

**(k) Selection for Award.**

(1) When a proposal is not selected for award, the proposer will be notified. NASA will explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will arrange a debriefing.

(2) When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation. The contracting officer may request certain business data and may forward a model award instrument and other information pertinent to negotiation.

(l) **Cancellation of NRA.** NASA reserves the right to make no awards under this NRA and to cancel this NRA. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation.

**Appendix E.**  
**FORMATS AND FORMS FOR PROPOSALS SUBMITTED TO THE**  
**SOLID EARTH AND NATURAL HAZARDS PROGRAMS**

**FOLLOW DIRECTIONS CAREFULLY**

**PROPOSALS MUST USE REQUIRED FORMATS AND SECTION NUMBERING AND  
ADHERE TO ALL PAGE LIMITS**

**PROPOSALS WHICH DO NOT FOLLOW THE REQUIRED FORMATS WILL BE  
RETURNED TO BE RE-SUBMITTED THE FOLLOWING YEAR**



**Required Proposal Cover Sheet (Page 1)**

**(Copy this form or prepare a facsimile on a word processor if additional space is required for various items. Length must not exceed one page)**

**NASA Research Announcement NRA-98-OES-13**

**Title:** \_\_\_\_\_

Principal Investigator: \_\_\_\_\_

Department: \_\_\_\_\_

Institution name: \_\_\_\_\_

Street/PO Box: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_ Country: \_\_\_\_\_

email: \_\_\_\_\_ Telephone: \_\_\_\_\_ Fax: \_\_\_\_\_

<b>Co-Investigator(s) :Name</b>	<b>Institution</b>	<b>Telephone</b>	<b>email</b>
_____	_____	_____	_____
_____	_____	_____	_____

**Requested Starting Date** \_\_\_\_\_ **Type of Institution:** \_\_\_\_\_

**Budget:** Year 1: \_\_\_\_\_ Year 2: \_\_\_\_\_ Year 3: \_\_\_\_\_ Total: \_\_\_\_\_

Other organizations to which this effort has been proposed: \_\_\_\_\_

**Certification of Compliance with Applicable Executive Orders and U.S. Code**

By submitting the proposal identified in this *Cover Sheet/Proposal Summary* in response to this Research Announcement, the Authorizing Official of the proposing institution (or the individual proposer if there is no proposing institution) as identified below:

- certifies that the statements made in this proposal are true and complete to the best of his/her knowledge;
- agrees to accept the obligations to comply with NASA award terms and conditions if an award is made as a result of this proposal; and
- confirms compliance with all provisions, rules, and stipulations set forth in the two Certifications contained in this NRA [namely, (i) *Certification of Compliance with the NASA Regulations Pursuant to Nondiscrimination in Federally Assisted Programs*, and (ii) *Certifications, Disclosures, And Assurances Regarding Lobbying, and Debarment & Suspension*].

Willful provision of false information in this proposal and/or its supporting documents, or in reports required under an ensuing award, is a criminal offense (U.S. Code, Title 18, Section 1001).

Title of Authorizing Institutional Official: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name of Proposing Institution: \_\_\_\_\_

Telephone: \_\_\_\_\_ E-mail: \_\_\_\_\_ Facsimile: \_\_\_\_\_

**Required Proposal Summary (Page 2)**  
**NASA Research Announcement NRA-98-OES-13**

**Title:** \_\_\_\_\_

**Principal Investigator:** \_\_\_\_\_

**Budget:** Year 1: \_\_\_\_\_ Year 2: \_\_\_\_\_ Year 3: \_\_\_\_\_ Total: \_\_\_\_\_

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**Program Area: See Appendix A of NRA for details. Check no more than 2**

- |  |       |
|--|-------|
| I. Dynamics of the Solid Earth                           |       |
| 1. Static and Time Variable Gravity Studies              | _____ |
| 2. Earth Orientation, Reference Frames, Angular Momentum | _____ |
| 3. Geomagnetism  | _____ |
| II. Topography & Surface Change                          |       |
| 1. GPS and INSAR Applications                            | _____ |
| 2. Global Sea Level Change                               | _____ |
| 3. Coastal Hazards                                       | _____ |
| 4. Flood Disaster Management Applications                | _____ |
| 5. Landslides  | _____ |
| 6. SRTM/Topography and Surface Change                    | _____ |
| III. Hazardous Consequences of Climate Variability       | _____ |
| IV. Thermal and Geothermal Hazards                       |       |
| 1. Wildfires   | _____ |
| 2. Volcanic Hazards                                      | _____ |
| V. Pacific Disaster Center                               | _____ |
| VI. Geologic Applications of Remote Sensing              | _____ |
| VII. Airborne Data Acquisitions/Pacific Rim Campaign     | _____ |

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Proposal Summary (Single spaced), objectives and justification, prior accomplishments, proposed work and methodology.

## **Required Proposal Format**

Page 1                    Cover Sheet - Use form on Page E-2

Page 2                    Proposal Summary - Use form on Page E-3

Pages 3 through 17 Proposal body and additional information with numbered sections and titles exactly as shown in capital letters below: Sections 1-8 must total no more than 15 pages double spaced using a 12 pt. font.

1.        RESEARCH OBJECTIVES
2.        RELEVANCE OF PROPOSED WORK
3.        EXPECTED RESULTS
4.        DETAILED WORK PLAN
5.        ROLE OF PI, CO-I, COLLABORATORS AND OTHER PERSONNEL
6.        DATA REQUIREMENTS
7.        SUPPORTING FACILITIES
8.        REFERENCES (may be single spaced)

Additional pages: Up to 2 additional pages containing figures with captions are permitted to follow the maximum 15 pages of the proposal body.

- 9A.        PRINCIPAL INVESTIGATOR RESUME  
(maximum of 2 pages, including at least 3 relevant publications).  
PRINCIPAL INVESTIGATOR CURRENT AND PENDING SUPPORT  
(for each grant or other source of support use the following format; separate each grant with a horizontal line; list current support first; include this proposal as the last item in the pending support list)  
STATUS: (current or pending)  
TITLE: (or short description if title is not informative)  
SOURCE OF SUPPORT (Agency name)  
PRINCIPAL INVESTIGATOR:  
AWARD AMOUNT AND PERIOD OF PERFORMANCE:  
PERSON-MONTHS OF SUPPORT: YR 1 \_\_\_\_ YR2 \_\_\_\_ YR3 \_\_\_\_  
(support provided or proposed for this person in each year of the work period of this Solid Earth and Natural Hazards proposal)

- 9B, 9C, etc.        Prepare a separate section for each co-investigator following the format for the Principal Investigator in Section 9A:  
CO-INVESTIGATOR RESUME  
CO-INVESTIGATOR CURRENT AND PENDING SUPPORT

10.        DETAILED BUDGETARY INFORMATION AND EXPLANATIONS (Include UNAVCO support request sheet, using format on page E-7, collaborating institution statements and budget, if necessary)

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED  
DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (MAR 1996)

(a)(1) The Offeror certifies, to the best of its knowledge and belief, that--

(i) The Offeror and/or any of its Principals--

(A) Are \* are not \* presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(B) Have \* have not \*, within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(C) Are \* are not \* presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in subdivision (a)(1)(i)(B) of this provision.

(ii) The Offeror has \* has not \*, within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.

(2) "Principals," for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF  
AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE,  
FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER  
SUBJECT TO PROSECUTION UNDER SECTION 1001, TITLE 18, UNITED STATES  
CODE.

CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO INFLUENCE  
CERTAIN FEDERAL TRANSACTIONS (APR 1991)

The offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that on or after December 23, 1989,--

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan, or cooperative agreement;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the offeror shall complete and submit, with its offer, OMB standard form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

(3) He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of \$100,000 shall certify and disclose accordingly.

## UNAVCO SUPPORT REQUEST FORM

The University Navstar Consortium (UNAVCO) Boulder Facility has been formally supporting NASA investigators in the use of Global Positioning System (GPS) equipment and technology for Earth studies since the early 1990's. UNAVCO will continue supporting investigators under the Solid Earth and Natural Hazards Research and Applications Program. The Boulder Facility provides to NASA grantees GPS equipment for episodic and continuous GPS measurements, engineering support for in-field measurements, technical consulting support for data collection, communications and management, data archiving support, and training and technology transfer as required by individual projects using GPS. In order to determine more accurately the scope and costs of this support role for individual NASA projects, any investigator requiring GPS support from the UNAVCO Boulder Facility is required to submit with their proposal in a summary the following information. Use the following numbered sections and keep the total length less than 2 pages. Single spacing may be used if necessary.

1. Principal Investigator Name, Institution and Contact Information.
2. List of Collaborators and Their Responsibilities with Emphasis on In-country Collaborators for Non-U.S. Projects.
3. Brief Discussion of Intended Science Goals, Preferred Style of GPS Data Collection (e.g., Episodic, Continuous, Real Time Kinematic), and Required Measurement Precision. Include Requirements for Any Associated Data Measurements, e.g. Meteorological, Tilt Meter, Seismic, Gravity, etc.
4. Approximate Dates and Location of Data Collection Activity Including Desired Density of Episodic Measurements, Number and Location of Permanent Stations, Methods of Mixing Continuous and Episodic Measurements, etc.
5. Equipment Requirements Including Short-term, Long-term, and/or Permanent Loan of Receivers, Antennas, Communications Equipment, Data Download Computers, Solar Panels, Monuments, Equipment Housing, Tripods, Tribrachs, etc. (See <http://www.unavco.ucar.edu> for sample equipment lists and budgets).
6. Requirement for Field Engineer Support Including Nature, Location and Time Frame of Support, Special Language Requirements, Special In-country Experience Requirements, Need for On-site Training of Project Personnel, Concerns About In-country Security/Safety Considerations for Project Staff, etc.
7. Any Known Special Hardware or Software Development Requirements, e.g. Data Translators for Special Receiver Types, Data Download Scripts for Special Download Platforms and Operating Systems, Special Monumentation Requirements, Special Power Requirements, etc.
8. Special Training and Technology Transfer Requirements, Especially for Foreign In-country Collaborators Including Preference for Training at the Boulder Facility vs. In-country Training.
9. Potential Means for Data Communications from Continuous Stations Back to Home Institution, UNAVCO Boulder, and/or the Crustal Dynamics Data Information Service (CDDIS), e.g. Internet Connection, Phone Modems, Manual Download and Mail Delivery, etc.
10. Requirement for Long-term Maintenance and On-site Support of Permanent Stations. Specify In-country Collaborator Role/Responsibility Related to Station Support.
- 11. Data Archiving Plan, Including Providing Access to Near Real Time Continuous GPS Measurements. Investigator responses to these questions will be used by the Solid Earth and Natural Hazards Program Office for determining the appropriate level of UNAVCO support for individual projects as part of the award decision for individual grants.**

**Complete information will assure a better and more complete evaluation of the necessity and cost-effectiveness of specific support requests.**

**APPENDIX F:**  
**Pacific Disaster Center Modeling and Simulation Program**

**INTRODUCTION AND SCOPE OF PDC MODELING AND SIMULATION:**

In cooperation with the Department of Defense Office of the Assistant Secretary of Defense (C3I), NASA seeks proposals to conduct research and development of applications for modeling the risks and consequences of natural and man-made disasters within Hawaii and around the Pacific Rim region. The overarching goals of this effort are not only to enhance the operational capability of the PDC, but also to: 1) create an environment that encourages research into and the development/use of advanced observational capabilities, data integration and information system technology, and modeling for improved disaster management capabilities; 2) fosters the development of the next generation data sets and analytical capabilities for disaster management; and, 3) promotes cooperative research and development partnerships among technologists, scientists, and disaster managers.

Proposed efforts should build on ongoing work and capabilities at the PDC and result in the delivery and integration of either a new capability, or an enhancement to an existing capability, that significantly improves the operational readiness and capability of the PDC. The following types of proposals will be considered acceptable for this effort:

- Development and delivery of new models or integration of an existing model into the PDC system. Improvements to existing models, additional new models, as well as the direct inter-comparison of existing PDC models are solicited here, thereby enhancing the ability of the PDC to tailor data products to different geographic areas and environmental parameters. Proposals for new models must be focused on the set of data products already identified by the PDC user community (this information is provided the Concept of Operations document on the NASA web site in support of this solicitation). New models must also be accompanied by the data sets (if necessary) that are needed to produce end products that the PDC can distribute to the emergency management community.
- Modification of existing models to work with and/or assimilate new (or different) types of data (e.g., remote sensing data, high-resolution digital elevation models, and GIS-based products) within the PDC GIS environment.
- Optimization (i.e., model adaptation to be applicable to different geographic regions) of new or existing models to operate specifically for the PDC area of responsibility. For example, incorporate high-resolution data sets of the PDC area of responsibility, or produce high-resolution results appropriate for local/regional disaster management operations.
- Identification, acquisition, preparation and delivery of relevant data necessary for operating modified or new models for geographic areas within the PDC area of responsibility. The provision of new data sets for the PDC geographic regions is insufficient in itself for support under this NRA; new data must be necessary for models and be integrated into the working model that enables the PDC to deliver routine products to the community.



- Development/delivery of model/simulation runs to be utilized as look-up tables for PDC operations.

#### **PDC BACKGROUND INFORMATION:**

The Pacific Disaster Center is a Federal center designed to provide value-added information products to support Federal, State, local, and regional emergency managers during all phases of disaster management (i.e., mitigation, preparedness, response and recovery) within the Pacific region. Disaster related information products that are generated at the PDC deal with natural phenomena or human-induced events that pose a threat to life and property. These events include storms (tropical storms, hurricanes/typhoons, flooding, wind damage, storm surge), volcanic activity (explosive eruptions, lava flows, mud flows, ash clouds, gas emissions), earthquakes, tsunamis, droughts, wildfires, release of hazardous materials, and others. To provide this critical information, PDC collects data and information from various sources and/or models, and uses advanced computing capabilities to fuse these data sets, analyzes the data sets, and uses automated geographic information systems to develop tailored emergency management products. PDC then disseminates these products via a robust communications architecture.

Currently, the area of operations of the PDC includes Hawaii, Alaska, and the Pacific Insular States of Guam, American Samoa, Marshall Islands, Northern Marianas, Palau, and the federated states of Micronesia. In April 1998 Public Law 105-174 expanded the area of interest of the PDC to match the area of responsibility of the Commander in Chief, Pacific Command. During FY 1999 the PDC will undertake facilities, systems, communications, and data enhancements to meet this broadened area of responsibility.

The primary information processing facility of the PDC is located at the Maui Research Technology Park, Kiehe, on the island of Maui. A second node is co-located with the Hawaii State Civil Defense Emergency Operating Center at Diamond Head on the island of Oahu. The Oahu node serves as the focal point for the PDC wide area communications network.

The PDC reached initial operating capability in April 1997. FY 1997-98 efforts have included development of an enhanced Geographic Information System (GIS), implementation of an emergency staffing capability, and enhanced communications connectivity to the Pacific Insular States. During FY 1997-1998, many Federal civil and DOD agencies have become involved in the PDC development through interagency working groups. Federal participants have included (but are not limited to) the National Oceanic and Atmospheric Administration, National Weather Service, U.S. Geological Survey, National Aeronautics and Space Administration (NASA), Federal Emergency Management Agency (FEMA), U.S. Department of Agriculture, Department Of Transportation, National Imagery and Mapping Agency, Navy Space Warfare Systems Office, U.S. Army Corps of Engineers, and USCINCPAC. Throughout development, the State of Hawaii has served as a key partner in developing the PDC. Additionally, a broad spectrum of Hawaii state/local agencies and businesses are participating as members of working groups, partners, and/or as registered users of the PDC.

PDC obtains data from a variety of Federal, State, local, regional, and commercial sources. In the future, this may include international sources. Using these data, PDC is capable of producing over 60 different information products, based on user needs defined by Federal, state, local, and

regional emergency managers. Examples of PDC products include daily weather situation reports, weather images, tsunami travel time maps, tsunami evacuation maps, flood inundation maps, annotated images of damaged areas, electronic situation display, storm tracking maps, maps of available shelters, etc. The products produced by the PDC are distributed exclusively to Federal, state, local, and regional emergency managers who are registered users of the PDC system via a protected Intranet. The public can access general information about the PDC, and other disaster related organizations and activities via the PDC public web page on the Internet (<http://www.pdc.org>).

A full description of the PDC and its operational capabilities in support of emergency managers in the Pacific Region can be found in the Concept of Operations documents are available on the PDC public access web site at <http://www.pdc.org>.

## **SUMMARY OF ONGOING EFFORTS**

A summary of the current state of data collection and modeling activities associated with the PDC can be found below. More detailed information in the form of tables is posted on the NASA web site in support of this solicitation.

### **Data Collections:**

The quality and utility of the PDC products are limited by the availability of input data sets of known accuracy and spatial/temporal coverage. For much of the original area of responsibility (i.e., the State of Hawaii), a significant number of GIS data planes exist describing land use, property, utility locations, and an archival satellite image data base. Digital topographic data at a spatial resolution of 10 m (derived from interpolated data with 30-m postings) also exist.

The quality and breadth of the PDC data base for other areas of interest around the Pacific are far less complete, and often comprise digitized versions of paper maps (for feature identification and topographic data) historic air photographs, and positional information based on a local coordinate system. Few satellite data sets exist at the PDC for the use in predictive models, or for pre- and post-event damage assessments.

A summary of the current data holdings is provided in a table on the NASA web site in support of this solicitation.

### **Model integration/Model improvements/Model Development**

The PDC models are run on a variety of platforms, including PC, UNIX, and SGI. Models are run under FORTRAN, C, MATLAB, and IDL. Models are run both in a predictive mode (often in response to real-time events) and in simulation mode to derive a series of look-up tables that can then be used should the appropriate set of environmental conditions pertain. Where appropriate, models will be ported to the MHPCC for parallel processing. In most cases, it is expected that the new models will be documented to a level sufficient to permit their adaptation by the PDC to other geographic areas of PDC responsibility.

The PDC has specific system interface standards that the successful proposal will use for integration of new models and databases. A summary of this information is provided in a table on the NASA web site in support of this solicitation.

Examples of the models currently being run or under integration development at the PDC include the CIC Oil Spill Model, Geo-Storm which calculates flood inundation areas, TAOS which predicts peak winds and storm surges, HAZUS97 which can predict earthquake damage to property, PMEL's integrated tsunami model, the UH/Scripps High Surf model, MM5 weather model, NWS-AMBER, NOAA Oil Spill model, UH Drought model, and the USGS/HVO Lava Flow model. Further information on these desired products is provided in a table on the NASA web site in support of this solicitation.

Typical data products to be generated with such models and data by the PDC in support of agency requirements include:

- GIS data layers that include land use information, topography, location of utilities, and tax code maps.
- Tsunami inundation maps based on the point of origin of wave, predictive models of maximum wave height, near-shore bathymetry, and shoreline topography.
- Maps of fire hazards based on the combination of known fire locations, the state and spatial extent of vegetation cover, local meteorology, and GIS data layers.
- Predictions of storm path trajectories and resultant damage to property based on mesoscale weather models, topographic information, local building codes, and land use maps for the islands.
- Predictions of the path of lava flows based on vent location, eruption rate, topographic information and rheological models for flow emplacement.
- Atmospheric dispersal maps for the distribution of aerosols, volcanic gases, or man-made pollutants based on weather models and local topographic information.

#### **GUIDELINES AND CONSIDERATIONS:**

In the preparation of proposals in response to this program element, proposers are strongly encouraged to consider the following points, which will be included in the evaluation process:

- Proposals must clearly address the mission of, and result in the enhancement of the operational capability of the PDC for modeling and simulation of the consequences of natural and man-made disasters.
- Proposals should draw on and leverage the scientific results and technology development associated with academia, NASA's Earth Science Program in general and the SENH program in particular, and other government agencies including NOAA, USGS, NSF, DOD, as well as development/operational activities at the PDC.
- Proposals should promote cooperative arrangements, within the PDC environment, between the research community and disaster managers in Federal, state, local and non-governmental organizations as well as the private-sector. Proposals that address modeling activities for any

hazard which a Federal Agency has a cognizant responsibility for warnings, prediction, of consequence assessment should include that agency within the cooperative arrangement.

- Proposals that establish cooperative arrangements involving the State of Hawaii, the University of Hawaii, high technology companies located in Hawaii, the PDC, and the Maui High Performance Computer Center are specifically encouraged. Proposed investigators are encouraged to consider extended stays at the PDC as visiting scientists to work on cooperative projects with team members, the PDC staff, and local users of the PDC.
- Proposals should clearly outline a delivery schedule within a 12 to 18 month period. A biannual schedule of deliveries to the PDC should be clearly identified. Optional enhancements may be proposed for up to an additional 12 month period.
- Proposals related to the development or refinement of numerical models should outline a clear plan for testing, evaluation, sensitivity analysis, installation, and acceptance testing by the appropriate cognizant Agency (if necessary). Proposals should also provide a complete description of the model assumptions, the input data type(s) and format, the model host platform, an estimate of the typical scenario run time, the output data type and format, data storage requirements, and an estimate of the associated costs of running and maintaining the model.

**CONTACT INFORMATION:**

Questions pertaining to this activity can be emailed to [oescomm@hq.nasa.gov](mailto:oescomm@hq.nasa.gov). Answers to these questions, along with the original questions, will be posted in the SENH section of the web site <http://www.earth.nasa.gov/nra/index.html> within 48 hours.